18 NEW TIPS, HACKS AND LESSONS LEARNED
FOR BEST PRACTICE SCAN-TO-BIM PROJECTS

INTRODUCTION

Scanning and modeling technologies are evolving so quickly that it's hard to keep up with the latest trends and techniques. To get everyone up to speed, ClearEdge3D convened four experts from the 3D modeling sector to reveal their favorite best-practice tips and hacks for making Scan-to-BIM projects more efficient and profitable. Our own Kelly Cone, VP of Product Management, added his insights as well.

We condensed all the advice and lessons learned into this report. The best tips and hacks are divided into three parts of the typical Scan-to-BIM project: Bidding and Project Planning, Field Collection, and Data Processing & Modeling.

THESE TIPS COME FROM SOME OF THE MOST EXPERIENCED 3D SCANNING AND MODELING PROFESSIONALS IN THE INDUSTRY:

GREG HALE
CTO AND CO-FOUNDER OF HALE TIP

JESSE HUYNH
TECHNOLOGY SOLUTIONS MANAGER AT VIATechnik

TED MORT
VP AND OPERATIONS MANAGER OF ECO 3D

KRIS NIXON
PRINCIPAL AND OWNER OF MERIDIAN 3D

BIDDING AND PROJECT PLANNING TIPS

1. INCORPORATE INDUSTRY SPECIFICATIONS INTO YOUR BIDDING AND PLANNING

One key way to ensure the client is satisfied with the end products you deliver is to get everyone speaking the same language with regards to expectations before the bid is even submitted. This is why industry standards are created. Led by the U.S. Institute of Building Documentation (USIBD), the AEC community had adopted Levels of Accuracy (LOD) and Levels of Development (LOA) for 3D laser scans and building information models (BIMs). LOA refers to accuracy of measurement, and LOD addresses the accuracy with which elements in the 3D model are represented.

Because LOAs and LODs pertaining to 3D deliverables are relatively new, you should become educated on them now and be ready to educate your prospects prior to the bidding process. This will ensure the client understands what their own expectations are and translate their desired accuracy and detail outcomes into the common language of LOA and LOD specifications. Certifications on achieving these levels of specifications, as well as discussion groups on best practices, can be found on the websites of the USIBD at www.usibd.org and the Associated General Contractors of America at www.agc.org.

"LOA and LOD help you plan for client expectations and make sure those expectations are met." — Greg Hale.

2. ENSURE ALL PARTIES UNDERSTAND SCOPE OF WORK WITH WRITTEN GUIDELINES.

Nothing kills profit margins faster than scope creep. Talking with the prospect before submitting a bid is crucial for them to communicate their expectations on exactly what the job will entail (i.e. areas to be scanned, features to be modeled) and what the LOD and LOA are. Talking isn't enough. The expected scope of work and final deliverables must be put in writing and included in the bid submission.

Asking 'Why?' is the critical question, according to Jesse Huynh. He recommends sitting down with the prospect and finding out why they want a space scanned and modeled in 3D. In other words, what is the end use application of the BIM going to be? Once the final application of the BIM or other end product is understood, it's much easier to create written guidelines as to how the scanning work will proceed to capture the right data at the right LOA and LOD. Huynh noted that many vendors have had the avoidable experience of going back to a job site to capture additional data because the deliverable didn't fully satisfy the client's intent and didn't realize it until late in the project.

*"The end of the project is not usually where things go south; it's the beginning." — Kelly Cone*

3. TAKE 360-DEGREE PHOTOS AND VIDEOS ON YOUR SITE VISIT

With modern digital camera technology, 360-degree photos of project sites are a fast, cheap and easy way to add context to any scanning job. And they benefit the scanning team as much as the end users. Greg Hale captures color panoramic photos with a $400 Ricoh Theta camera when he's gathering site information prior to his bid. The photos help his team see where tight or difficult scanning space are that will likely require extra scans. For scan technicians that weren't on the site visit, the photos get them acquainted with the field work before they arrive. During modeling, the color photos sometimes help the BIM technicians differentiate between features and changes in building materials in the black-and-white point clouds.

Hale says his clients like the 360-degree photos so much that his firm now offers them as a value-added product to the BIM deliverables. Since the 3D scans and point clouds are black and white, the color photos give context that help the client better understand the BIM. Most clients gladly buy the accompanying images, especially in construction and design projects.

"Photos increase communication with the team and add context to the 3D deliverable." — Greg Hale
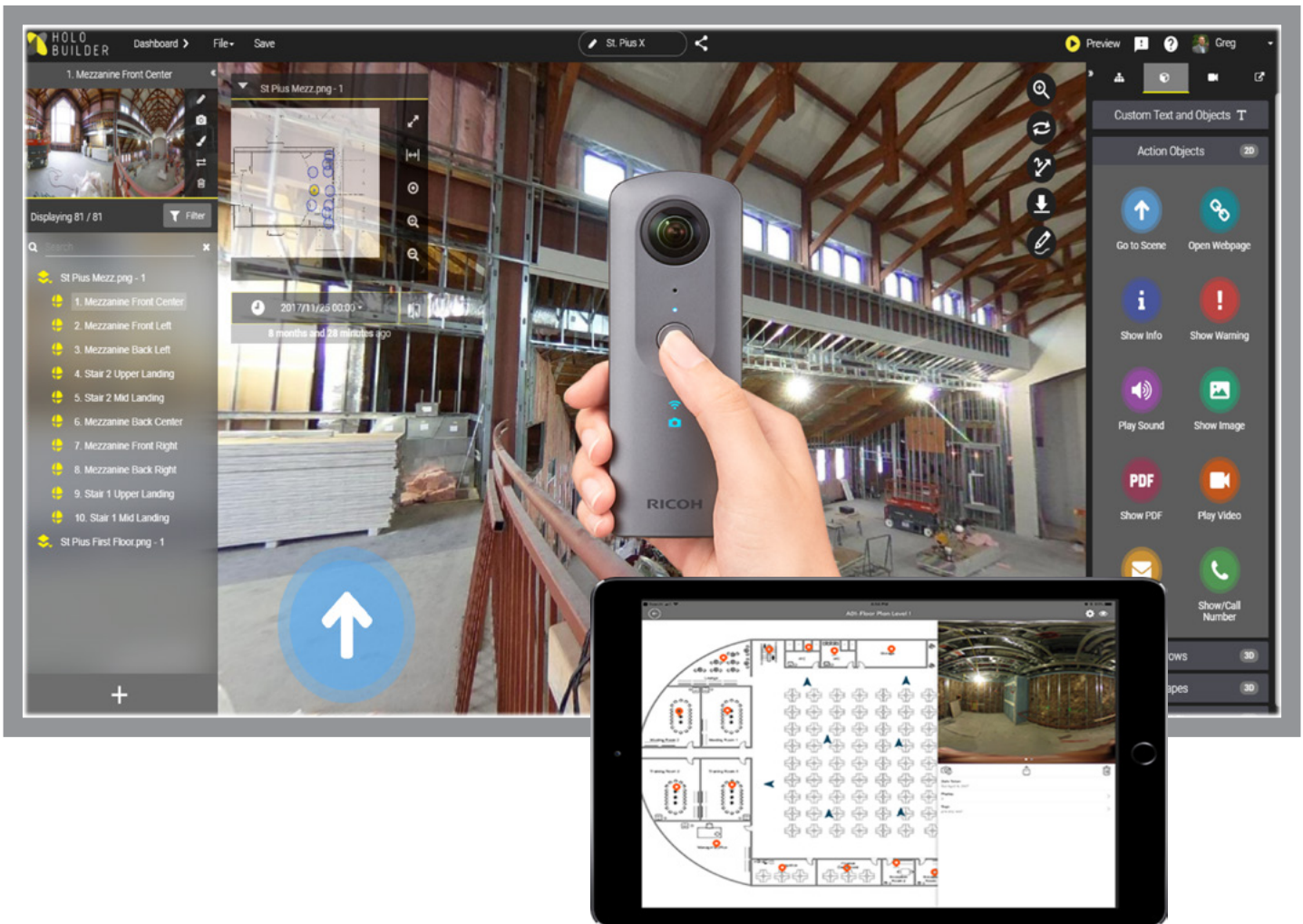
4. DETERMINE WHAT METRICS THE CLIENT WILL USE TO EVALUATE YOUR PROPOSAL

Start with the client's budget. As uncomfortable as the conversation might be, find out if the prospect has a budget number, or even a price range, in their head before you spend days or weeks working on the proposal. It's not uncommon for a client to have an unreasonable expectation of how much they want to spend and what they will get. If the price is too low, you may have to bail on the bid, but you may also have the opportunity to educate the client about what the technology can achieve for them – and at what price points.

Other prospects may be savvy about basing their vendor selection on firm experience and product accuracy. This is a good sign, but the prospect might still need education to understand that a higher level of accuracy and detail will likely require additional scans to be collected on site, which will increase the price of the overall project. As noted above, some clients may need a higher level of accuracy for their ultimate application but not realize it. Again, it's up to you to educate them in advance that their application will dictate LOA and LOD which will drive costs.

"Beware the 'Give me your best price' client."
— Kris Nixon

5. PREPARE SITE MANAGERS AND EMPLOYEES FOR YOUR FIELD WORK

Some facilities are more difficult to scan than others due to access issues—hospitals, manufacturing plants, and live construction sites, for example. But the scan crew needs access to the entire space to capture comprehensive scans and achieve success in the overall project. That's why Ted Mort recommends getting to know the 'gatekeeper' in advance. This person is usually a security professional or facility manager. They literally have the keys to the kingdom. Get on their good side and make sure they understand in advance that scanning requires physical access to the entire facility, Mort advises.

In many cases, scan work occurs when the plant, hospital, or office is in full operating mode. A scanning crew showing up

unexpectedly can be a major distraction for personnel onsite. If possible, drop in on a staff meeting in advance and let employees know what you will be doing. This will minimize the likelihood they interrupt your work or that you'll disrupt theirs.

"You'll be amazed at how a cup of coffee in the morning can win over the gatekeeper."
— Ted Mort

6. DO NOT BID WITHOUT ANSWERING THESE FIVE QUESTIONS

1. Who is the decision maker?

Find out who will ultimately make the final bid selection and try to meet them before submitting. Whether this person is the CEO or CFO, they will likely need education on what they can expect for various budgets. Knowing in advance if the decision will be made by the BIM user or the accountant will influence how you write your proposal.

2. What is the budget?

As noted above, if you know the client's budget, the discussion (and your proposal) evolves into, "Here's what I can provide you for that price."

3. What is the project goal?

Your objective is to find out how the final deliverable will be used immediately and in the future. As described earlier, the end use lets you work backwards to determine the scan accuracy and BIM detail that will satisfy your client.

4. Are budget and scope expectations aligned?

Disappointment occurs when deliverables don't meet expectations. You can't let this happen. Find out in advance what the client expects, or you might end up returning to the site to collect more data on your own dime. Worst case scenario is you get a reputation for not providing the client with the deliverables they expected.

5. Are there opportunities for value-added deliverables?

The client may be new to 3D laser scanning and building modeling. Let them know if there are value-added services or products, like the 360 photos, that you can provide at minimal extra cost to them. Often a small additional deliverable yield great value to the customer, something they will keep in mind when they next need a scanning vendor.
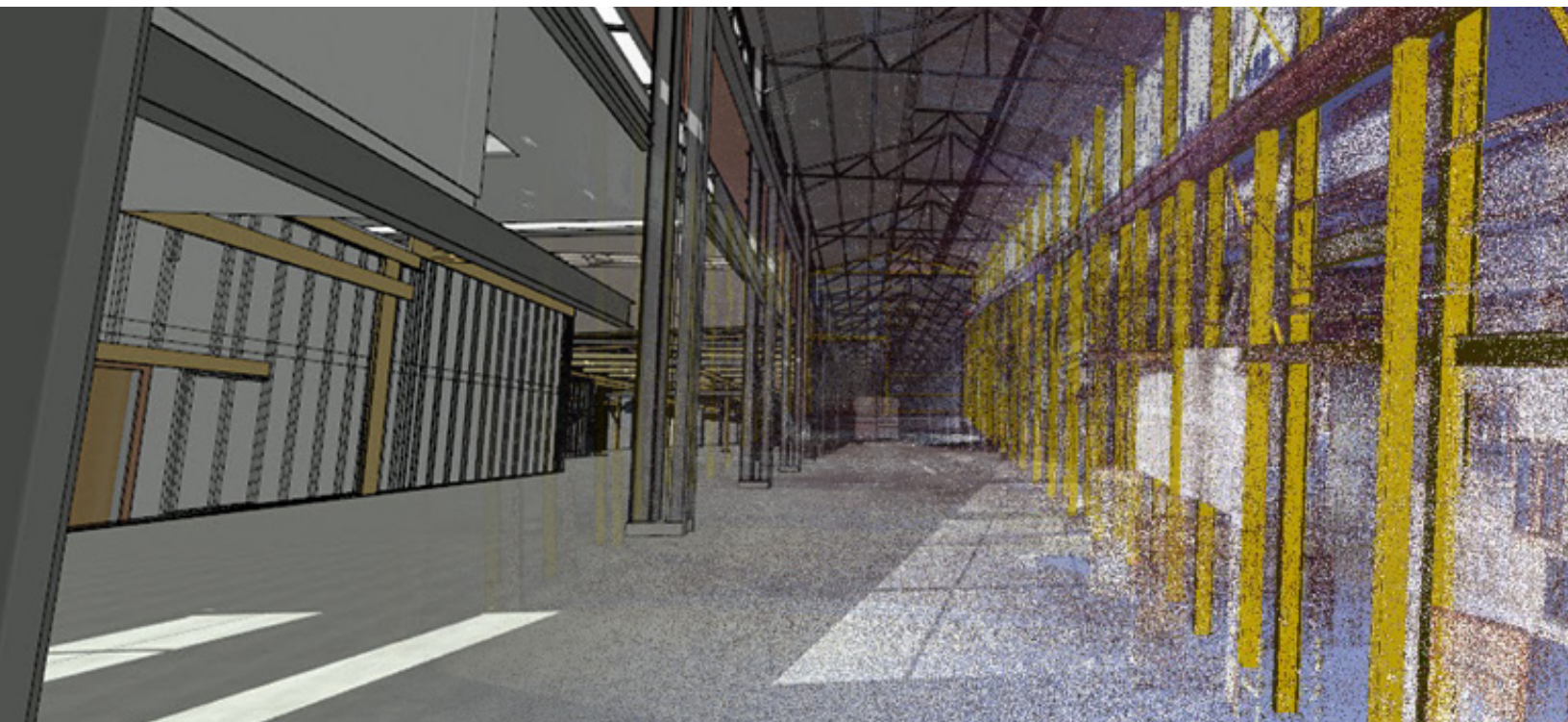
7. PLAN TO USE MULTIPLE COLLECTION DEVICES

Now is a great time for the reality capture industry because 3D laser scanning technology is evolving faster than it ever has. For the creators of 3D as-builts and BIMs, this means you can choose one or more different types of devices for a project. The most common equipment options are Stationary Terrestrial, Mobile Handheld, Mobile Backpack, and Drone-Mounted scanners. As you plan your scanning project, expect to use multiple scanners based on the needs of the site and the advantages of each capture technique.

Greg Hale now prefers to deploy his drone, or Unmanned Aerial Vehicle (UAV), on projects where a building roof top must be scanned. Even when it's possible to put a technician and stationary scanner on the roof, Hale prefers not to take the risk and let the drone fly over the potentially dangerous site instead. Mobile scanners, either handheld or backpack, are becoming increasingly used in residential and office buildings when they are occupied and active. Mobile scanners let the data capture crew get in and out quickly without bothering people in the building.

"These tools complement and supplement each other." — Greg Hale

8. KNOW ACCESS RESTRICTIONS TO THE PROJECT SITE AND PLAN ACCORDINGLY

The field team's primary goal is to get in and out with maximum efficiency. This requires advanced planning, especially if the site is an active facility where access is limited. Visit the site in advance, recommends Jess Huynh, and walk it with a site manager whenever possible to get the scoop about areas that may be restricted in general or at certain times of the day. Take note of areas that will require extra scan collection, such as extremely dense equipment rooms, and plan to spend extra time there.

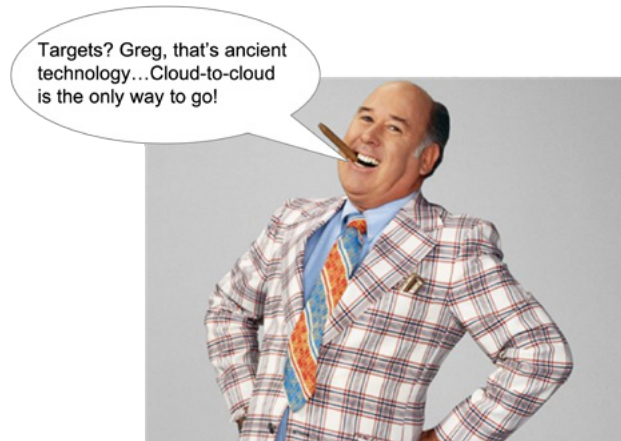It's also important during the site visit to make note of areas that will require prepa-ration in advance, especially if it means ar-riving a day before the scanning. In some facilities, furniture and equipment may need to be moved to ensure a clean scan is captured. In addition, very reflective surfac-es might need to be covered so they don't add noise to the point cloud. The time for this prep work must be built into the sched-ule, often with access permission required in advance.

"You want to capture optimal scans...and that might require multiple days onsite." — Jesse Huynh

9. IGNORE THE TARGET-LESS HYPE MACHINE

Contrary to opinions floating around the reality capture industry, there are still situations when targets are not only useful, but a necessity for tying scans together and into the local survey coordinate system, according to Greg Hale.

Targets? Greg, that's ancient technology…Cloud-to-cloud is the only way to go!

In general, you will need targets in large outdoor space where there are no planar objects, such as buildings, to use as references. You will also find targets very convenient when scanning up in a ceiling plenum space to serve as the tie in between the ceiling space and the floor space below. And while targets are not necessities in scanning L-shaped corridors, they can cut the number of scans in half.

Cloud-to-cloud techniques can be used in place of targeting in outdoor space with solid planar objects that don't bend in the wind like trees or drive away like cars. Moreover, cloud-to-cloud may be a necessity in facilities where targets can't be used either because they will be moved or regarded suspiciously. Construction sites are notorious, according to Hale, for having targets 'walk away,' and airports tend to trigger too many reports to security if strange spheroids are placed all around. Though cloud-to-cloud techniques are becoming more popular, the use of targets remains alive and well.

"Don't listen to the target-less hype from sales people." — Greg Hale

10. EMPLOY AN EQUIPMENT SAFETY PLAN

Equipment will get damaged, but there are steps that can be taken to minimize the risk. According to Ted Mort those simple steps should be built into every project plan because the cost of a broken scanner might far exceed its price tag. It can bring a project to standstill.

At Mort's company, crews are trained to keep their equipment safe, and it starts with the Arm's Length Rule. Studies show that most damage occurs when the device is out of sight or out of reach of the technician. Keeping the

scanner never more than arm's length from the user dramatically reduces risk. Another important rule is to use support gear that exceeds the weight specification of the scanner that it will hold. Some firms are trying to lessen the amount of equipment they take into the field by having tripods perform double duty for cameras and scanners. But most camera tripods can't handle the weight of a terrestrial laser scanner.
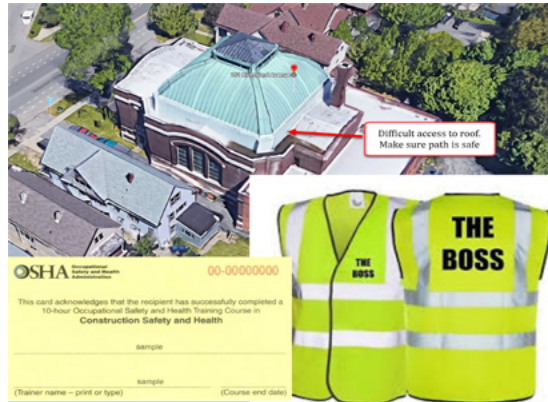
"Put tethers on your magnetic targets so if they fall off an object they don't hit the ground and break." — Kelly Cone

11. ENSURE YOUR TEAM'S SAFETY

Construction sites, industrial plants, and many other facilities can be dangerous places for scanning crews. The best way to prevent injury is to train every member of the field team. Greg Hale recommends every technician receive at least 10 hours of standard OSHA-approved safety training.

The next important layer of personal protection is safety gear. At a minimum, every person in the crew should wear a bright yellow safety vest. Not only does this increase visibility, but it also alerts personnel in the area that important work is being conducted, prompting them to be on the lookout for danger, as well. Each member of the field crew should also come equipped with a hardhat, safety glasses and steel-tip boots.

Include notes on hazardous areas within the overall job site in the scanning plan so field technicians know in advance they must employ extra caution when entering that zone. It's important for the field crew to know how to get themselves and their equipment into a particularly hazardous area. A quick escape plan should also be put in place for extremely dangerous sites within plants and other industrial facilities.

"Always highlight danger zones in your plans."
— Greg Hale

12. REDUCE THE KNOWLEDGE GAP BETWEEN THE FIELD AND BACK OFFICE

The goal is to give the modeling team as clear a picture as possible of the scanning environment, advised Ted Mort. In an ideal world, every employee would be trained in field data capture and data processing and modeling, but the reality is that our industry is getting more specialized. With so much work to do, field technicians now specialize in data capture, and the modeling experts in the office focus on creating point clouds and BIMs. This has made communication between the field and office more important than ever so the modelers have a full understanding of conditions on the job site.

Ted Mort has spent considerable time eliminating this field-to-office knowledge gap. His firm has created standardized note taking forms on tablets so that every person in the field delivers the right information and details about how the scans were collected. And his team has begun using 360-degree cameras to snap photos of the project site, enabling the modelers to refer to the pictures when trying to interpret point clouds for a location they have never visited in person. These two steps can significantly enhance the overall quality of the delivered BIMs.

"If at all possible, have the modeling team visit the project site to see it first hand." — Ted Mort

DATA PROCESSING AND MODELING HACKS

13. FIVE EXPERT HACKS TO BETTER PROCESS TARGET-LESS DATA

✳ Restrict target-less scans to dead end spaces.

✳ Go target-less in above ceiling spaces.

✳ Cluster your target-less scan together for accurate registration.

✳ Add elevation notes to your scan acquisition maps so back office

knows if they were captured from ground level or above.

✳ Clean your scans before registration.

"Link to a photo in your scan notes to show where the capture occurred." — Greg Hale

14. PERFORM QA BEFORE AND AFTER REGISTRATION

Don't wait until the end of the registration process to check the accuracy of your work. The worst thing that can happen is you find yourself chasing down registration errors late in the modeling process. Take several cross sections of the point cloud and inspect them visually throughout the registration.

Jesse Huynh said his team now routinely cuts out a floor plan from the model to

visualize only the walls and compare them to the point cloud to see where the scans are off. This is done long before they begin modeling.

"Registration is where a lot of technical mistakes occur, and it's hard to go back and fix them after modeling...so check registration early." — Kelly Cone

15. CHECK FOR FEATURES REMAINING IN THE POINT CLOUD

Whether feature extraction and modeling are an automated or manual process, it's possible that some elements will remain unmodeled in the point cloud, overlooked by the technician. To avoid this scenario, Kelly Cone recommends exporting just the points that have not yet been modeled to

isolate them and extract those elements. ClearEdge3D has just added an automated feature called Remainder Cloud??? to find unmodeled features.

"Automated software finds things the human eye misses." — Kelly Cone

16. DON'T OVER-MODEL

Stay on top of your modeling team and make sure they only model what was promised in the scope of work. In theory, it may sound nice to over-model and deliver more to the client than promised in the project scope. But modeling features beyond what you bid on can have two negative consequences. The first is that it raises client expectations to the point where they will start expecting to get extra work for free, which can come back to bite you in future projects. Secondly, modeling features that weren't included in the project specifications can create problems when the client raises questions about the quality of those features.

Kris Nixon recommends providing the modeling team and the client with a mock-up model or sketch that shows precisely the level of detail that will be included in the final product.

"It's easy for enthusiastic modelers, especially if they are subcontractors, to over-model when they get excited about a project."
— Kris Nixon

17. CHECK AND RECHECK MODEL ACCURACY

Don't jump into Quality Control and randomly check the accuracy of the model, recommends Jesse Huynh. You must have a logical plan to methodically check elements in the model. His group has a standard procedure that involves taking small cross sections from the bottom of a floor plan, checking the alignment of features, and then moving to the next cross section. This ensures that even small deflections are spotted in the model.

Ted Mort has begun experimenting with automated QC software, such as ClearEdge3D's Verity, which leverages the power of the computer to check model accuracy against the digital design plans. Working much faster and more comprehensively than manual methods, automated software checks to ensure features are in place and also measures their deviation from designed location.

"When you model 10,000 elements, it's hard to manually make sure you have them all correct."
— Kelly Cone

18. GET THE CLIENT INVOLVED IN QA/QC

Getting the client involved in multiple phases of a 3D BIM project makes good business sense, but especially so during QA/QC. Jesse Huynh recommends dividing the modeling into chunks and using filters in Revit to flag small segments that have been completed. His team sends these finished model segments to the client for their approval and sign-off. If there's a problem, the client can raise the red flag early and get the project back on track before it's too late. Keeping the client engaged throughout the process also builds a bond between you and your customer, making future job assignments more likely.

"Involving the client in quality control work greatly improves the acceptance of final deliverables by the client." — Jesse Huynh

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